



Designation: G90 – 23

Standard Practice for Performing Accelerated Outdoor Weathering of Materials Using Concentrated Natural Sunlight¹

This standard is issued under the fixed designation G90; the number immediately following the designation indicates the year of original adoption or, in the case of revision, the year of last revision. A number in parentheses indicates the year of last reapproval. A superscript epsilon (ϵ) indicates an editorial change since the last revision or reapproval.

1. Scope*

1.1 Linear Fresnel reflector concentrators using the sun as source are utilized in the accelerated outdoor exposure testing of materials.

1.2 This practice covers a procedure for performing accelerated outdoor exposure testing of materials using a linear Fresnel reflector, accelerated outdoor weathering, test machine. The apparatus (see Fig. 1 and Fig. 2) and guidelines are described herein to minimize the variables encountered during outdoor accelerated exposure testing.

1.3 This practice does not specify the exposure conditions best suited for the materials to be tested but is limited to the method of obtaining, measuring, and controlling the procedures and certain conditions of the exposure. Sample preparation, test conditions, and evaluation of results are covered in existing methods or specifications for specific materials.

1.4 The linear Fresnel reflector accelerated outdoor exposure test apparatus described may be suitable for the determination of the relative durability of materials when these materials are exposed to concentrated sunlight, heat, and moisture.

1.5 This practice establishes uniform sample mounting and in-test maintenance procedures. Also included in the practice are standard provisions for maintenance of the machine and linear Fresnel reflector mirrors to ensure cleanliness and durability.

1.6 This practice shall apply to specimens whose size meets the dimensions of the target board as described in 8.2.

1.7 For test machines currently in use, this practice is not recommended for specimens exceeding 13 mm (1/2 in.) in thickness because of specimen cooling.

¹ This practice is under the jurisdiction of ASTM Committee G03 on Weathering and Durability and is the direct responsibility of Subcommittee G03.02 on Natural and Environmental Exposure Tests.

Current edition approved July 1, 2023. Published August 2023. Originally approved in 1985. Last previous edition approved in 2017 as G90 – 17. DOI: 10.1520/G0090-23.

1.8 Values stated in SI units are to be regarded as the standard. The inch-pound units in parentheses are provided for information only.

1.9 *This standard does not purport to address all of the safety concerns, if any, associated with its use. It is the responsibility of the user of this standard to establish appropriate safety, health, and environmental practices and determine the applicability of regulatory limitations prior to use.*

1.10 *This international standard was developed in accordance with internationally recognized principles on standardization established in the Decision on Principles for the Development of International Standards, Guides and Recommendations issued by the World Trade Organization Technical Barriers to Trade (TBT) Committee.*

2. Referenced Documents

2.1 ASTM Standards:²

- D859 Test Method for Silica in Water
- D1014 Practice for Conducting Exterior Exposure Tests of Paints and Coatings on Metal Substrates
- D1435 Practice for Outdoor Weathering of Plastics
- D1898 Practice for Sampling of Plastics (Withdrawn 1998)³
- D4141 Practice for Conducting Black Box and Solar Concentrating Exposures of Coatings
- D4364 Practice for Performing Outdoor Accelerated Weathering Tests of Plastics Using Concentrated Sunlight
- D4517 Test Method for Low-Level Total Silica in High-Purity Water by Flameless Atomic Absorption Spectroscopy
- D5722 Practice for Performing Accelerated Outdoor Weathering of Factory-Coated Embossed Hardboard Using Concentrated Natural Sunlight and a Soak-Freeze-Thaw Procedure
- E816 Test Method for Calibration of Pyrheliometers by Comparison to Reference Pyrheliometers

² For referenced ASTM standards, visit the ASTM website, www.astm.org, or contact ASTM Customer Service at service@astm.org. For *Annual Book of ASTM Standards* volume information, refer to the standard's Document Summary page on the ASTM website.

³ The last approved version of this historical standard is referenced on www.astm.org.

*A Summary of Changes section appears at the end of this standard

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|--------------------------|-----------------------------|
| A - AIR PLENUM | H - MAST, AZIMUTH ADJUST |
| B - AIR BLOWER | I - AIR FLOW SWITCH |
| C - ROTOR ASSEMBLY | J - WATER SPRAY NOZZLE |
| D - AIR DEFLECTOR | K - CLUTCH DISC, ELEV DRIVE |
| E - A-FRAME ASSEMBLY | L - SOLAR CELLS/SHADOW HAT |
| F - MIRROR | M - SAMPLE PROTECTION DOOR |
| G - GEAR BOX, ELEV DRIVE | N - DOOR RELEASE MECHANISM |

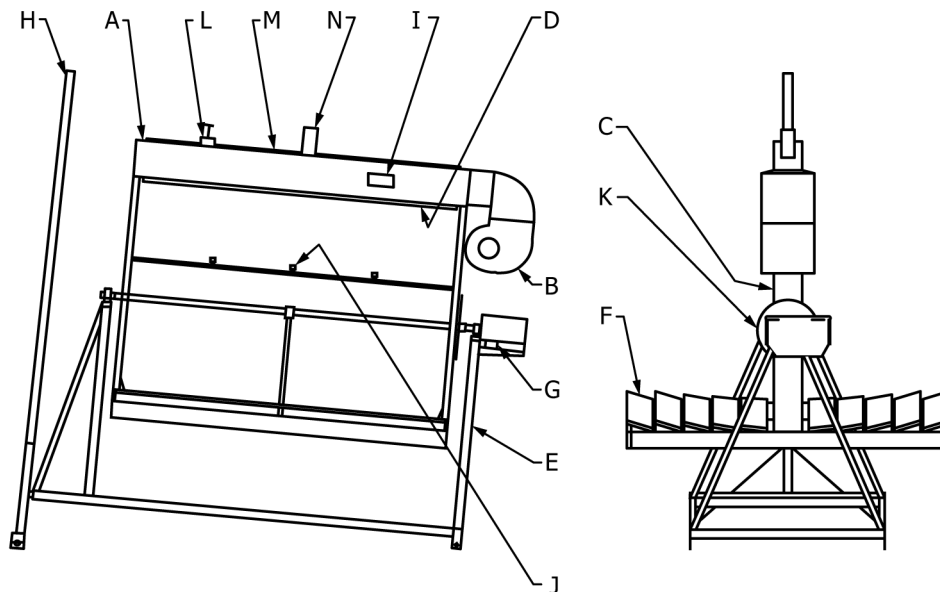


FIG. 1 Schematic of Linear Fresnel Reflector Concentrator Accelerated Weathering Machine Single Axis Tracking

- E824 Test Method for Transfer of Calibration From Reference to Field Radiometers
- E903 Test Method for Solar Absorptance, Reflectance, and Transmittance of Materials Using Integrating Spheres
- G7 Practice for Natural Weathering of Materials
- G24 Practice for Conducting Exposures to Daylight Filtered Through Glass
- G113 Terminology Relating to Natural and Artificial Weathering Tests of Nonmetallic Materials
- G130 Test Method for Calibration of Narrow- and Broad-Band Ultraviolet Radiometers Using a Spectroradiometer
- G167 Test Method for Calibration of a Pyranometer Using a Pyrhemometer
- G169 Guide for Application of Basic Statistical Methods to Weathering Tests
- G173 Tables for Reference Solar Spectral Irradiances: Direct Normal and Hemispherical on 37° Tilted Surface
- G179 Specification for Metal Black Panel and White Panel Temperature Devices for Natural Weathering Tests

2.2 Other Standards:

- SAE J576 Plastic Materials for Use in Optical Parts Such as Lenses and Reflectors of Motor Vehicle Lighting Devices⁴
- SAE J1961 Accelerated Exposure of Automotive Exterior Materials Using A Solar Fresnel Reflector Apparatus
- WMO Guide to Meteorological Instruments and Methods of Observation WMO No. 8, Fifth Edition⁵
- 2.3 ISO Standards:⁶
 - ISO 4892-1 Plastics— Methods of Exposure to Laboratory Light Sources—Part 1: General Guidance
 - ISO 9060 (2018) Specification and Classification of Instruments for Measuring Hemispherical Solar and Direct Solar Radiation

⁴ Available from SAE International (SAE), 400 Commonwealth Dr., Warrendale, PA 15096-0001, <http://www.sae.org>.

⁵ Available from World Meteorological Organization, Geneva, Switzerland.

⁶ Available from International Organization for Standardization (ISO), ISO Central Secretariat, BIBC II, Chemin de Blandonnet 8, CP 401, 1214 Vernier, Geneva, Switzerland, <http://www.iso.org>.

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|--------------------------|-----------------------------|
| A - AIR PLENUM | I - GEAR BOX, AZIMUTH DRIVE |
| B - AIR BLOWER | J - AIR FLOW SWITCH |
| C - ROTOR ASSEMBLY | K - WATER SPRAY NOZZLE |
| D - TURN TABLE ASSEMBLY | L - CLUTCH DISC, ELEV DRIVE |
| E - A-FRAME ASSEMBLY | M - SOLAR CELLS/SHADOW HAT |
| F - MIRROR | N - SAMPLE PROTECTION DOOR |
| G - GEAR BOX, ELEV DRIVE | O - DOOR RELEASE MECHANISM |
| H - CONTROL BOX | P - AIR DEFLECTOR |

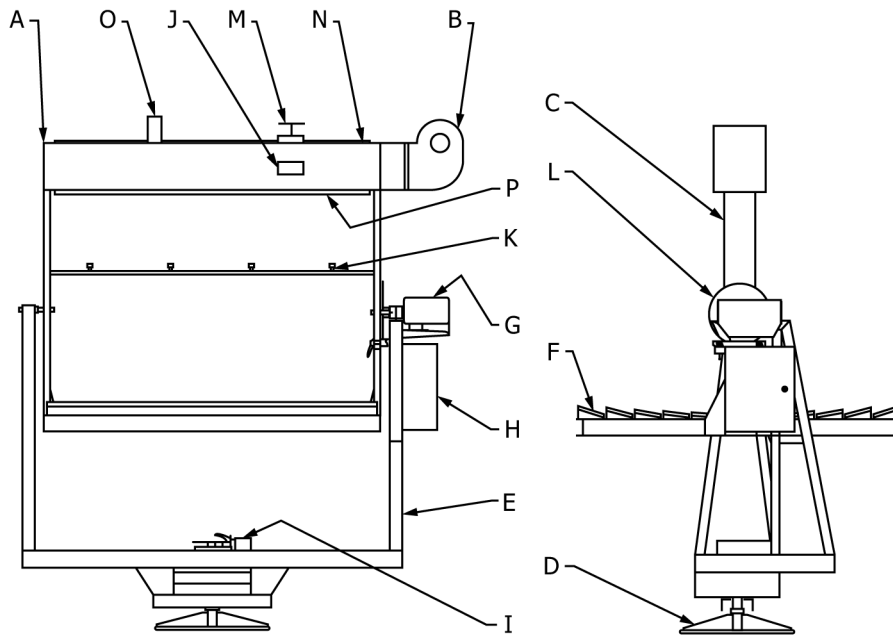


FIG. 2 Dual Axis Tracking

3. Terminology

3.1 Definitions:

3.1.1 Definitions of terms common to G03 durability standards can be found in Terminology **G113**.

3.2 Definitions of Terms Specific to This Standard:

3.2.1 *linear Fresnel reflector, n*—an array of long narrow segments of mirrors to concentrate sunlight onto a fixed receiver located at a common focal point of the reflectors.

4. Significance and Use

4.1 Results obtained from this practice can be used to compare the relative durability of materials subjected to the specific test cycle used. No accelerated test can be specified as a perfect simulation of natural or field exposures. Results obtained from this practice can be considered as representative of natural weathering only when a sufficient magnitude of mathematical correlation exists between exposures.

4.2 The acceleration factor relating the rate of degradation in this accelerated exposure to the rate of degradation in a

natural weathering exposure varies with the type and formulation of the material. Each material and formulation may respond differently to the increased level of irradiance and differences in temperature and humidity. Thus an acceleration factor determined for one material may not be applicable to other materials. For this reason, the use of a single acceleration factor is not recommended. Also, a different acceleration factor may be obtained by using different mirror types and configurations. Because of variability in test results for both accelerated and natural weathering exposures, results from a sufficient number of tests must be obtained to determine an acceleration factor for a material. Further, the acceleration factor is applicable to only one exposure location because results from natural weathering will vary due to seasonal or annual differences in climatic factors.

4.3 The relative durability of materials determined by this practice can be used to determine the relative durability of the materials exposed under natural weathering conditions provided the materials have similar acceleration factors. However,